Int. J. Production Economics ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Int. J. Production Economics

journal homepage: www.elsevier.com/locate/ijpe

Institutional pressures and support from industrial zones for motivating sustainable production among Chinese manufacturers

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ARTICLE INFO

Article history:
Received 8 August 2015
Accepted 9 November 2015

Keywords:
Sustainable production
Institutional pressure
Support from industrial zones
Manufacturers
China

ABSTRACT

Institutional pressures drive manufacturers to implement sustainable production (SP) practices. Support from an industrial zone where a manufacturer is located is also important, but the role of industrial zones for SP practices lacks of related studies. This paper aims to understand how institutional pressures (coercive, normative and mimetic) and support from industrial zones, respectively and collectively, motivate SP practices. Using 422 samples of Chinese manufacturers from 31 provinces, an exploratory factor analysis indicates five factors on SP related to efficient consumption of materials, water, energy and land from the life cycle perspective. Results of hierarchical regression analysis reveal that normative pressure motivates most SP practices except land saving practices without the need of support from industrial zones. Coercive pressure can bring SP practices related to saving of resources including water, land and energy while support from industrial zones is needed for land and energy saving practices. Mimetic pressure only motivates SP practice on land saving while support from industrial zones is necessary. This paper defines SP considering the Chinese context, including practices on efficient consumption of materials, water, energy and land from the life cycle perspective. It also extends institutional theory to include support from industrial zones to examine motivation mechanism for SP practices among manufacturers, especially in emergent economies. Empirical results provide implications for governments that support from industrial zone should be highlighted to promote SP practices among manufacturers.

1. Introduction

Sustainable production (SP) has been promoted since the late of 1990s (de Ron, 1998). Many studies examine how to reduce pollution emissions (Hankle, 2008) and resource consumption (Henningsson et al., 2004) through SP practices. Some studies have focused on sustainable energy production (Bacellar and Rocha, 2010; Briguglio et al., 2010; Pappas et al., 2012; Safarzynska and van den Bergh, 2011). In the recent years, SP has been combined with sustainable consumption as a systematic way for sustainable development (Le Blanc, 2010; Liu et al., 2010; Staniskis et al., 2012). However, no common definition exists for SP. Leading companies have implemented SP practices and gained win-win benefits for both economic return and environmental protection (Holliday, 2001). Unfortunately, many companies are still reactive to make efforts on SP. How to effectively motivate SP among companies still needs more exploration.

Previous studies indicated that companies have implemented SP practices, and identified different pressures mainly from perception of industrial managers. Govindan et al. (2015) identified 12 drivers on SP practices and compare relationships among these drivers using a fuzzy Multi Criteria Decision Making approach. Schrettle et al. (2014) considered environmental regulations, societal values and norms, and market as three clusters of drivers to develop conceptual models for motivating SP practices. Forster (2015) found that cost reduction, customer demands, and legal requirements can be potential for the implementation of various SP-related technologies but barriers such as costs associated with large investments exist. Cuerva et al. (2014) examined the needed resources to motivate SP among small companies, and put forward that governments need to reduce financial constraints for eco-innovation (Cuerva et al., 2014).

This paper aims to theoretically develop pressures and understand motivation mechanisms of SP practices based on empirical results. China is the global manufacturing base, and thus, data from Chinese manufacturers were collected as empirical samples. This paper first contributes to define SP considering four resources of materials, water, land and energy from the life cycle perspective. It applies the institutional theory to develop and identify pressures

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http://dx.doi.org/10.1016/j.ijpe.2015.11.009
0925-5273/

for SP practices. Besides, support from industrial zones is critical since most manufacturers are located in industrial zones. Thus, this paper extends the institutional theory to include a motivator about support from industrial zones. Hierarchical regression analysis is used to reveal the motivation mechanism for SP practices using 422 samples of Chinese manufacturers.

This paper is organized as follows. Section 2 defines SP based on literature review of SP practices and the related background in China followed by two hypotheses about relationships of institutional pressures and support from industrial zones with SP practices. Section 3 will introduce the methodology, including items development, data collection and exploratory factor analysis. In Section 4, general descriptive statistics will be introduced first, and then hierarchical regression analysis will be used to test two hypotheses, followed by discussions and implications. Section 5 will summarize the whole paper with conclusions from the study and identify future research directions.

2. Literature review and hypotheses development

2.1. Literature review on sustainable production in the industry

SP was defined as early as 1998. According to de Ron (1998), SP is industrial production which can result in a product that can benefit sustainability through its whole life cycle. Thus, concurrent engineering techniques were put forward for SP implementation among companies to achieve a continuous improvement of efficiency, quality and flexibility for production. In the early of 1990s, innovation business models for SD were studied on if and how to achieve both economic and environmental performance (Mont, 2002; Senge and Carstedt, 2001). At that time, policies and consumers generally could not exert pressure while reduced cost due to less emissions and resource use through SP could bring economic incentives (Cerin and Karlson, 2002). However, some leading companies such as DuPond demonstrated that they could improve economic, environmental and social performance simultaneously by SP efforts (Holliday, 2001). In 2003, eco-design for developing sustainable products and service became a key element of cleaner production (Maxwell and van der Vorst, 2003).

Since 2004, preventive measures for SP have been put forward (Christianova, 2004). Source reduction rather than end-of-pipe solutions was put forward to achieve waste minimization from a life cycle perspective for a sustainable production and consumption system (Henningsson et al., 2004; Tarantini et al., 2004) . Originally, studies on SP were mainly about how to produce materials such as metal (Moors, 2006), ceramic (Hankle, 2008) and chemical products with minimized pollution and resource consumption through a product life cycle. Since 2007, sustainable energy production has gained an increasing attention (Bilen et al., 2008; Yilmaz and Uslu, 2007). Such studies focused on renewable or clear energy production (Briguglio et al., 2010; Hernandez and Kafarov, 2009; Soyhan, 2009).

A systematic perspective was put forward in 2011 for SP implementation, either through supply chains of products (Niinimaki and Hassi, 2011) or cooperation among different companies in the same industrial zone (Lehtoranta et al., 2011). A systematic model of sustainable production and consumption was developed to minimize consumption of energy and material use as well as wastes (Staniskis et al., 2012). Therefore, research areas on SP have been extended to global sustainable production, product life cycle management, and green supply chain management (Chun and Bidanda, 2013). Design for sustainable production was introduced as a systemic approach to deal with challenges for sustainability and globalization simultaneously (Garbie, 2013).

In recent years, researchers on SP have continued to examine how to reduce consumption of resources such as water and production of pollution such as waste water while minimization of CO2 emissions has become a key goal of SP (Alkaya and Demirer, 2014). Some researchers have developed methodologies to monitor economic, environmental and social aspects of SP (Henriques and Catarino, 2015). A new trend of SP is to identify decoupling tools to keep economic gains while at the same time reduce environmental burdens (Nieuwenhuis and Katsifou, 2015)

2.2. Background of sustainable production in China and a definition

SP in China has been mainly motivated by regulations (Dong et al., 2012; Wang et al., 2011). China has promoted SP practices through two main laws. The first law is the Cleaner Production Promotion Law, which was enacted on January 1, 2003. The update version was passed on February 29, 2012, and has been implemented since July 1, 2012. The second law is the Circular Economy Promotion Law, which was passed on August 29, 2008. It has been implemented since January 1, 2009.

The Cleaner Production Promotion Law aims to create a favorable policy and develop an institutional framework to promote SP (Hicks and Dietmar, 2007). Two key instruments of the law are environmental impact assessment (EIA) and compulsory cleaner production audit (CPA). According to the law, all newly-built and re-built projects have to pass EIA, which requires analysis and evaluation on raw materials use, resources consumption as well as pollutants production and treatment, and encourages use of high efficient cleaner production skills, technologies and equipment. For three types of companies, compulsory CPA is needed. The first type of companies are those discharging pollutant emissions over national or local standards or requirements due to the total amount control. The second type of companies are energy intensive, and their energy consumption by unit product is over the quota. The third type of companies are those using toxic and hazardous materials or discharging toxic and hazardous pollutants during production.

The Circular Economy Promotion Law aims to promote a new development way which can decouple economic growth and environmental protection (Greyson, 2007; Mathews and Tan, 2011). Thus, the law highlights resource saving as well as product and materials recovery. It requires all governments over the county level should develop circular economy plans, and such plans should promote saving of energy, water, materials and land. Besides, the law requires governments at all levels to establish related statistic systems. Since manufacturing companies with high resource consumption or pollution are mainly located in industrial zones, one key Chinese circular economy policy is to develop eco-industrial zones (Mathews and Tan, 2011).

Besides regulatory requirements, SP in China has also been motivated by economic reasons. Export was the key driver for manufactures to implement environmental practices (Zhu et al., 2005). Manufacturers in China also demonstrated that SP can bring both environmental and economic gains through cleaner technologies (Guo et al., 2006). Thus, Chinese manufacturers have made efforts to develop and apply cleaner technologies for SP practices (Guo et al., 2006; Kong and White, 2010). The technology development related to SP practices was indentified to contribute the most for the productivity growth in China (Wang and Feng, 2015). However, insufficient technological investment has prevented Chinese manufacturers from SP practices such as those for energy efficiency promotion (Wang et al., 2012).

Based on the literature review and the Chinese background, this paper defines SP as practices that are related to saving of energy, water, materials and land from the life cycle perspective.

Please cite this article as: Zhu, Q., Institutional pressures and support from industrial zones for motivating sustainable production among Chinese manufacturers. International Journal of Production Economics (2015), http://dx.doi.org/10.1016/j.ijpe.2015.11.009